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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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System for coupling two tubular ends for use in a well bore and connecting assembly for such a system

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SYSTEM FOR COUPLING TWO TUBULAR ENDS FOR USE IN A WELL BORE AND CONNECTING ASSEMBLY FOR SUCH A SYSTEM

The present invention relates to a system for coupling two tubular ends for use in a well bore. The invention further relates to a connecting assembly for such a system.

In oil well drilling and completion operations, drill strings are used. These drill strings often comprise various types and sized of tubular components like drill pipes, drill collars, liner, casing, and tubing in various configurations. In coupling such tubular ends, sometimes functionality is required, such as rotatablity of one end with respect to an adjacent end.

It is an object of the invention to provide an improved system for coupling two tubular ends for use in a well bore.

In accordance with the invention, there is provided a system for coupling two tubular ends for use in a well bore, the system comprising a first tubular end, a second tubular end for inserting into the first tubular end in axial alignment thereof, thereby forming an annular space between the first tubular end and the second tubular end, and a connecting assembly for axially coupling the first tubular end with the second tubular end whereby the connecting assembly at least partly reaches in the annular space.

The provision of a separate connecting assembly between the tubular ends, allows for adding additional functionality to the system. This functionality can conveniently be provided by a selection of a customised connecting assembly, and therefore the system is easily

adaptable to custom need. Due to its at least partial reach into the annular space, the connecting assembly is protected from the outside by the tubular ends themselves that are connected by the connecting assembly.

For instance, the connecting assembly may be provided with one or more of the following features.

In one embodiment the connecting assembly comprises one or more units. Each unit itself is arranged for axially coupling the first tubular end with the second tubular end. Hence, these units may either act individually or in concert with other units.

Preferably, two or more units are interconnected so as to form a string of interconnected units.

A unit can comprise a first fixture element, a second fixture element, and a spacer element for coupling the first fixture element to the second fixture element and maintaining an axial displacement between the first fixture element and the second fixture element.

Herewith it is achieved that in addition to the coupling assembly serving to couple the first and second tubular ends, there is added functionality in that an axial displacement is maintained between the coupling points on the respective tubular ends. By providing the separate spacer element the coupling functionality is separated from the other mentioned functionality in the coupling assembly.

In an embodiment, the spacer element comprises means for adjusting the axial displacement. Herewith it is achieved that the fixture elements can for instance be coupled to their respective tubular ends in a course way, while the axial displacement can subsequently be altered in a more controlled way without having to uncouple one or both of the fixture elements.

In an embodiment, the spacer element comprises a bearing element cooperating with a bearing plane that is

essentially perpendicular to the alignment axis, whereby the first fixture element is rotatable with respect to the second fixture element about the alignment axis.

Herewith a system for rotatably coupling the tubular ends is provided.

In an embodiment, the spacer element comprises resilient means for providing axial resilience to the tubular ends when coupled.

In an embodiment, the second tubular end comprises a locking portion having an essentially circular circumference. Here with it is achieved that a locking mechanism based on relative rotation of the second fixing element and the second tubular end can be provided.

Preferably, the second fixture element is shaped to embrace the locking portion over essentially its full circumference. Herewith an even distribution of the axial force between the first tubular end and the second tubular end over the locking portion is achieved. Also, this geometry is advantageous for centring other features of the connecting assembly around the second tubular end.

In an embodiment, the second locking means comprises at least one couple of cooperating locking rim segments, one locking rim segment of which couple being provided on the locking portion of the second tubular end and one locking rim segment of which couple being provided on the second fixture element. By bringing the couple of cooperating locking rim segments in axial alignment, the second fixture element is locked to the second tubular end such as to transfer axial force from one to the other. By relative rotation around the alignment axis, the segments can be brought to axial misalignment, in which position the second fixture element is no longer locked. Herewith the second fixture element is quickly mountable to and/or dismountable from the second tubular end.

In an embodiment, the first locking means comprises an opening provided through a sidewall of the first tubular end, a receiving opening in the first fixture element, and an insertable locking member for extending through the opening and reaching in the receiving opening when in axially locked condition. The second tubular end with the connecting assembly already mounted on it, can be inserted into the first tubular end and locked by bringing the receiving opening in the first fixture element into alignment with the opening in the sidewall of the first tubular end and inserting the insertable locking member. Herewith it is achieved that the complete connecting assembly can be mounted to the second tubular end without being hindered by the embracing first tubular end.

The invention will described hereinafter in more detail and by way of example, with reference to the accompanying drawings in which:

Fig. 1 schematically shows a longitudinal section along line A-A* of an embodiment of the system according to the invention;

Fig. 2 schematically shows a cross sectional view of system of Fig. 1 along line B-B;

Fig. 3 schematically shows a cross sectional view of system of Fig. 1 along line C-C;

Fig. 4 schematically shows a cross sectional view of system of Fig. 1 along line D-D; and

Fig. 5 schematically shows a cross sectional view of system of Fig. 1 along line E-E.

In the Figures like reference signs relate to like components.

Referring to Fig. 1 there is schematically shown a longitudinal section of one embodiment of the system for coupling two tubular ends in axial alignment for use in a well bore. The system as shown has first and second

circular tubular ends that are rotatably coupled, whereby the second tubular end 1 is inserted into the first tubular end 4. The second tubular end 1 acts as axis 1, whereas the first tubular end 4 is shown in the form of housing 4. The tubular ends 1,4 are in axial alignment of each other, extending around alignment axis 20.

An annular space 15 is formed between the axis 1 and the housing 4. A connecting assembly 16 reaches into the annular space 15. The connecting assembly is shown in the form of three units 17,18,19 that are interconnected so as to form a string of interconnected units. It is not essential to the invention to have three units, a different number of units, including one unit, may be preferred. Each unit is in itself arranged for axially coupling the first tubular end with the second tubular end. Axis 2 has a bore of a given diameter.

Still referring to the embodiment of Fig. 1, each unit 17,18,19 in the connecting assembly 16 contains identical parts. In other embodiments, however, the various units may be composed of different parts.

The units are provided with a first fixture element in the form of housing fitting 6 and a second fixture element in the form of fixture nut 2. Neighbouring units are interconnected via the respective fixture elements, for instance, unit 17 is interconnected with unit 18 via the fixture nut 2, and unit 19 is interconnected with unit 18 via the housing fitting.

The housing 4 is provided with a number of holes in its side wall, with a tolerance diameter in the circumference. Fig. 1 shows insertable locking members in the form of pins 5 that are placed in the holes and reach in and are retained by receiving openings provided in the housing fittings 6. The pins 5 may be fixed by a screw 7 or the like, preferably having a tapered head 9. There

are seals 8 between the housing 4 and the pin p and between the pin 5 and the screw 7.

A cross section along line B-B is schematically depicted in Fig. 2, showing the housing 4, the housing fitting 6, and the axis 1, the housing 4 being provided with four holes in the circumference through which holes the pins 5 extend and reach into receiving openings in the housing fitting 6. The screws 7 having the tapered heads 9 are shown to fix pins 5 to the housing fitting 6.

Fig. 1 further shows a locking portion in the axis 1 that has a circular circumference, and is provided with locking rim segments 21. Five locking rim segments 21 are shown, but any suitable number depending on strengths considerations may suffice. The fixture nut 2 is shaped to embrace the locking portion. The fixture nut 2 is also provided with a number of locking rim segments 22. The number of locking rim segments, in the present embodiment six, is in accordance with the number of locking rim segments 21 in the axis 2. Preferably he axial faces of the locking rim segments 21 on the axis 2 are essentially in a plane perpendicular to centre line 20 such that they do essentially not function as thread windings.

Cross sections along lines C-C and E-E in the locking portions of axis 2 are schematically depicted in Fig. 3 and Fig. 5, respectively, showing the housing 4, the fixture nut 2, and the axis 1. Fig. 3 shows the locking rim segments 21 external on axis 1, while Fig. 5 shows the locking rim segments 22 provided inwardly in the fixture nut 2. As can be seen, three locking rim segments are provided evenly distributed over the circumference. A different number of locking rim segments is also possible. The total fraction of the circumference that is occupied by the locking rim segments should be at most 50%. For instance, by having approximately only half or less of the total circumference covered by the locking

rim segments, the fixture nut 2 can be conveniently installed by first shifting it axially through the open slots to the locking portion on the axis 1, and then, by applying a rotation of the fixing nut 2 relative to the axis 1, engaging the external rim segments 21 on the axis 1 and the internal rim segments 22 in the nut. Preferably, a securing device 3, such as a bolt, should be applied such that any relative rotation between the axis 1 and the fixture nut 2 is prevented and the locking rim segments 21,22 remain engaged for axial load transfer.

It will be understood that the remainder of the axis between its end and the locking portion should preferably either have a sufficiently small external diameter, or sufficiently large segments wherein the external diameter is sufficiently small to enable the shifting of the fixture nut 2 to the locking portion. In Fig. 2, for instance, can be seen spline segments 23, which spline segments 23 have a larger external diameter than the majority of the axis 1, and the orientation of which on the axis 1 axially corresponds to that of the locking rim segments 21.

The housing fitting 6 and the fixture nut 2 are coupled to each other with a spacer element, which in the embodiment of Fig. 1 comprises the following components as described herebelow. The spacer element serves to couple the housing fitting 6 to the fixture nut 2, and to maintain an axial displacement between the housing fitting 6 and the fixture nut 2.

Referring again to Fig. 1, the spacer element in unit 19, which is essentially identical to the ones in units 17 and 18, is provided with bearings 10. Bearings 10 cooperate with a bearing plane that is perpendicular to the alignment axis 20. As a result, the housing fitting 6 is rotatable about the alignment axis

with respect to the fixing nut 2. When the system is coupled, the tubular ends are consequently rotatable with respect to each other.

The bearings 10 are mounted in between the housing fitting 6 and a sliding ring 11. On the axis 1 the earlier mentioned spline profile 23 has been provided at the position underneath the sliding ring 11, for instance by machining. A corresponding opposite profile 24 has been provided on the inner of the sliding ring 11, for instance by machining. This is best shown in Fig. 4 in the cross section along line D-D. The siding ring 11 is therefore able to freely slide along the axis 1, whereby the interlocking spline profiles 23,24 prevent any relative rotation.

Also provided is resilient means in the form of a spring 13, in particular a disc spring. Spring 13 is preferably mounted in between two support members in the form spring support rings 12,14. Preferably the spring support rings are hardened for they may suffer from wear caused by strained movement of the spring 13.

As can be seen in Fig. 1, the sliding rings 11 extend underneath the bearings 10 on one side, and underneath the spring support ring 12 and spring 13 on its other side, such that these are centred on the axis 1.

The spring 13 and spring support ring 14 is supported by means for adjusting the axial displacement between the housing fitting 6 and the fixture nut 2, the means for adjusting here presented in the form of an adjustment nut 15. The adjustment nut 15 has an internal spline profile 25, which allows it to be slid though the previously mentioned various splines and rim segments present along the axis during installation and/or mounting. At the position underneath adjustment nut 15 the axis 1 is spline free. The adjustment nut 15 is connected to the fixture nut 2 via a threaded profile 26.

The threaded profile 26 may be as fine as is needed for obtaining sufficient adjustment accuracy. The treaded profile 26 is understood to include fixture nut thread on the fixture nut 2 and a cooperating adjustment nut thread on the adjustment nut 15 acting as the spacer element thread.

The cross section depicted in Fig. 3 also shows the adjustment nut 25 adjustably engaged via the tread 26 with the fixture nut 2.

Because of the above described design, the adjustment nut 15 can be rotated relative to the fixture nut 2 and, when the fixture nut is in locked position, relative to axis 1. This rotation will be accompanied by an axial displacement of the adjustment nut 15 relative to the fixture nut 2, due to the lead of the threaded connection between the adjustment nut 15 and the fixture nut 2.

It is remarked that the individual parts in the above described embodiment are advantageously designed such that they are readily machinable and mountable in an industrially applicable manner.

For play-free assembly of the connecting assembly 16 onto axis 1, an additional assembly tool may be applied that is temporarily placed over the connecting assembly when the housing 4 is not yet in place. This is particulary useful in the case that the connecting assembly comprises bearings. The assembly tool (not shown) may have two strips with pins that have the same diameter as the openings provided in housing 4. The positions of the pins on the strips of the assembly tool have been calibrated and fixed to the positions of the openings in the housing 4. After the calibration of the assembly tool pin positions, all internal parts of the connecting assembly are mounted on the axis 1. Hereby, the fixture nuts 2 have already been locked to the axis 1. All other parts are still loose in direction.

Then the assembly tool is mounted along axis 1, via a clamping ring. In addition, the pins on the assembly tool strips are temporarily fixed to the housing fittings 6.

The relative positions of the housing fittings 6 along the connecting assembly have now been fixed. By adjusting the adjustment nuts 15 the bearings 10 can be fixed at the correct axial positions and with out any axial play.

After removal of the assembly tool, the housing 4 can be installed over the connecting assembly and the pins 5 can be inserted with no problem.

The above described embodiment allows for a reliable transfer of axial force from the axis 1 to the housing 4. The bearings can be centred, and the embodiment allows for a bearing suspension plane that is perpendicular to the alignment axis of the housing 4 and the axis 2. Moreover, the bearings are mountable on the axis 2 without axial play, whereby the position of the bearings relative to the fixture elements can be adjusted. When a string of units is applied each having bearing means, the individual bearings can thus pick up load simultaneously.

The connecting assembly in the embodiment of the system described above provides combined functionality by means of an adjustable spacer element, a bearing element, resilient means, and other mentioned parts. Although the embodiment is preferred, the scope of the invention is not limited to a connecting assembly and a system wherein the functionality is combined in the described way. Embodiments only showing a spacer element, which may be an adjustable spacer element, or resilient means, or means for providing rotatablity, in particular bearing means, or any other means for a preferred functionality, or any combination of these features, may be advantageously applicable in operations.

(67)

C L A I M S

1. System for coupling two tubular ends for use in a well bore, the system comprising a first tubular end, a second tubular end for inserting into the first tubular end in axial alignment thereof, thereby forming an annular space between the first tubular end and the second tubular end, and a connecting assembly for axially coupling the first tubular end with the second tubular end whereby the connecting assembly at least partly reaches in the annular space.

2. System according to claim 1, wherein the connecting assembly comprises one or more units each of which unit being arranged for axially coupling the first tubular end with the second tubular end.

3. System according to claim 2, where the connecting assembly comprises two or more units, whereby the units are interconnected so as to form a string of interconnected units.

4. System according to claim 2 or 3, wherein at least one of the units comprises a first fixture element, a second fixture element, and a spacer element for coupling the first fixture element to the second fixture element and for maintaining an axial displacement between the first fixture element and the second fixture element.

5. System according to claim 4, further comprising first locking means for axially locking the first fixture element in an inner surface of the first tubular end and second locking means for axially locking the second fixture element on an outer surface of the second tubular end.

6. System according to claim 4 or 5, wherein the spacer element comprises means for adjusting the axial displacement.

7. System according to claim 4 or 5, wherein the spacer element is adjustable by means of an engagable thread connection, preferably whereby the first fixture element and/or the second fixture element is provided with fixture element thread and the spacer element is provided with spacer element thread for adjustably engaging with the fixture element thread.

8. System according to any one of claims 4 to 7, wherein the spacer element comprises a bearing element cooperating with a bearing plane that is essentially perpendicular to the alignment axis, whereby the first fixture element is rotatable with respect to the second fixture element about the alignment axis.

9. System according to any one of claims 4 to 8, wherein the spacer element comprises resilient means for providing axial resilience to the tubular ends when coupled.

10. System according to any one of claims 5 to 9, wherein the second tubular end comprises a locking portion having an essentially circular circumference, and the second fixture element is shaped to embrace the locking portion over essentially its full circumference.

11. System according to claim 10, wherein the second locking means comprises at least one couple of cooperating locking rim segments, one locking rim segment of which couple being provided on the locking portion of the second tubular end and one locking rim segment of which couple being provided on the second fixture element.

12. System according to any one of claims 5 to 11, wherein the first locking means comprises an opening provided through a sidewall of the first tubular end, a

receiving opening in the first fixture element, and an insertable locking member for extending through the opening and reaching in the receiving opening when in axially locked condition.

13. Connecting assembly for coupling two tubular ends in axial alignment for use in a well bore in accordance with the connecting assembly as defined in any one of the previous claims.

A B S T R A C T

SYSTEM FOR COUPLING TWO TUBULAR ENDS FOR USE IN A WELL BORE AND CONNECTING ASSEMBLY FOR SUCH A SYSTEM

System for coupling two tubular ends for use in a well bore, the system comprising a first tubular end, a second tubular end for inserting into the first tubular end in axial alignment thereof, thereby forming an annular space between the first tubular end and the second tubular end, and a connecting assembly for axially coupling the first tubular end with the second tubular end whereby the connecting assembly at least partly reaches in the annular space.

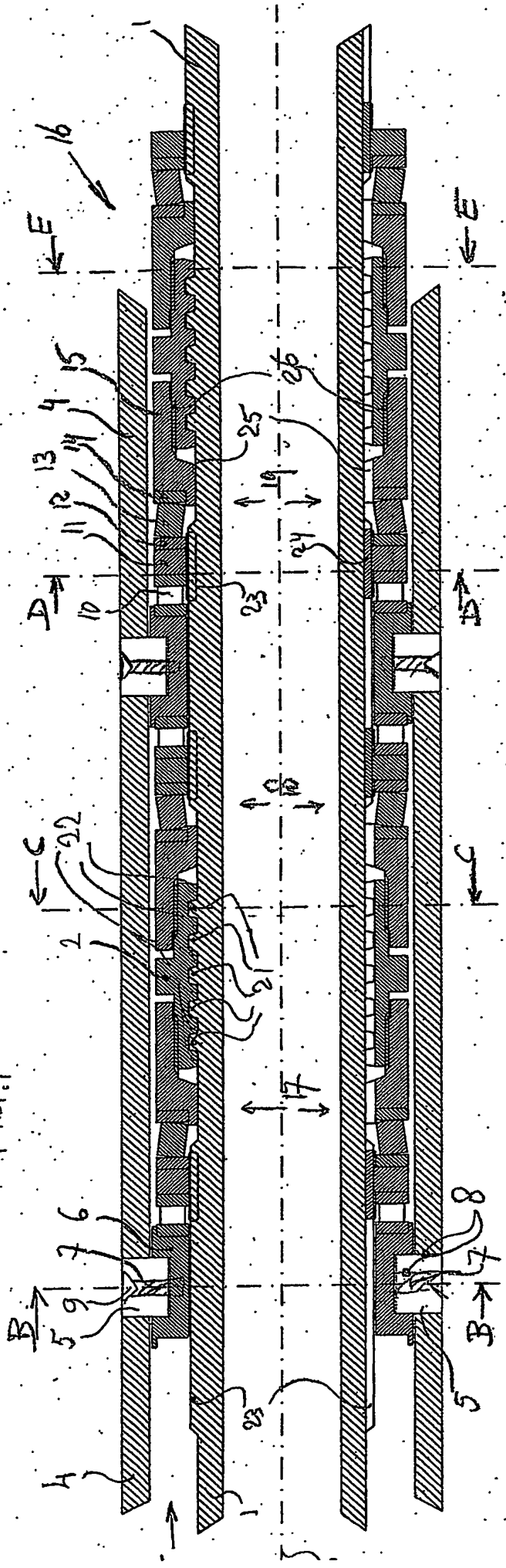

FIG. 1

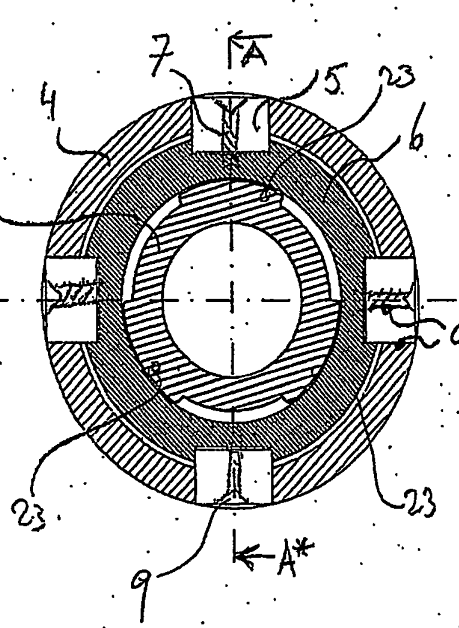

FIG. 2

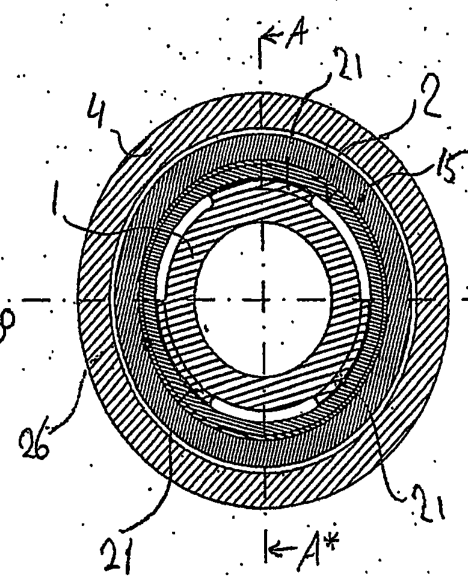

FIG. 3

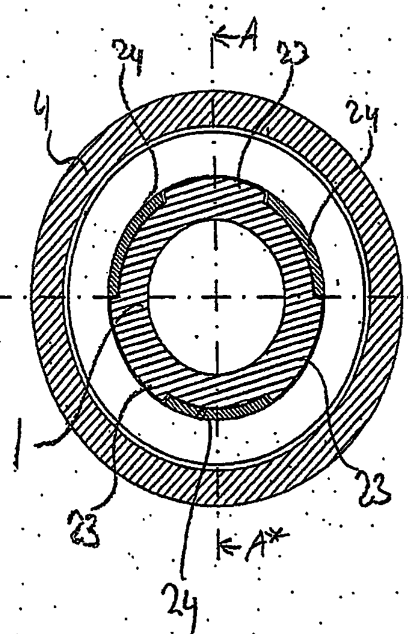

FIG. 4

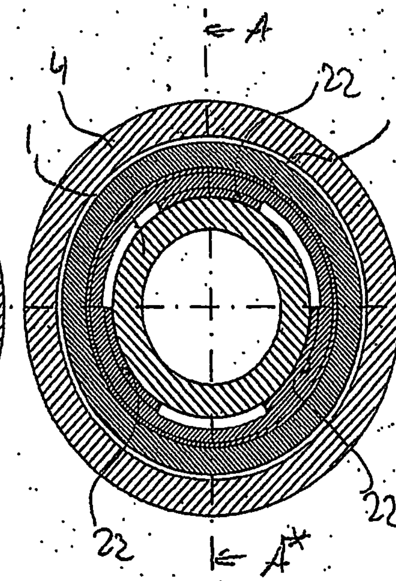

FIG. 5

TS 6417 EPC

PCT Application

PCT/EP2003/050991